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GB 1308568 A **US 4124095 A**

(58) Field of Search
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(54) Self-propelled lift truck with engine speed control

(57) The truck is of the kind having a mast, a lifting carriage movable up and down the mast by a hydraulic cylinder, a hydraulic control circuit for the cylinder, and a drive motor operable both to drive the truck through a transmission and to drive a hydraulic pump for pressurising the supply circuit, fluid flow in the hydraulic circuit being controlled by the vehicle operator through a hydraulic valve (40). The truck includes means (20) which automatically increase the speed of the drive motor, eg by acting on the throttle cable 12, in response to operation of the hydraulic valve to minimise the likelihood of stalling the engine when a load is being lifted. The invention provides control means (43, 45, 46) responsive to a transmission mode of the truck which operates to disengage this mechanism when the vehicle is in forward or reverse drive so as to avoid its operation affecting movement of the vehicle; the control means can be manually activated and deactivated by a switch (48).

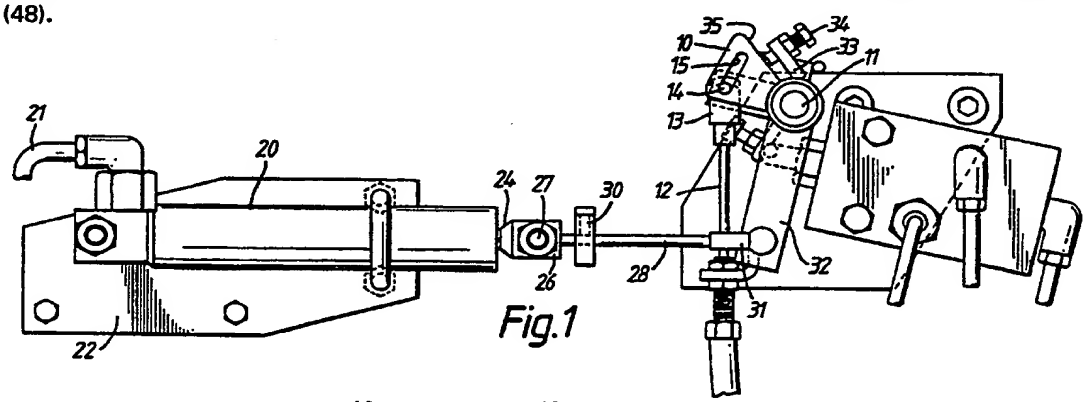

Fig.1

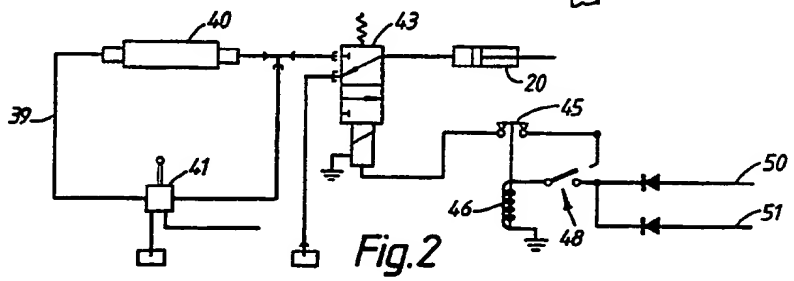

Fig.2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

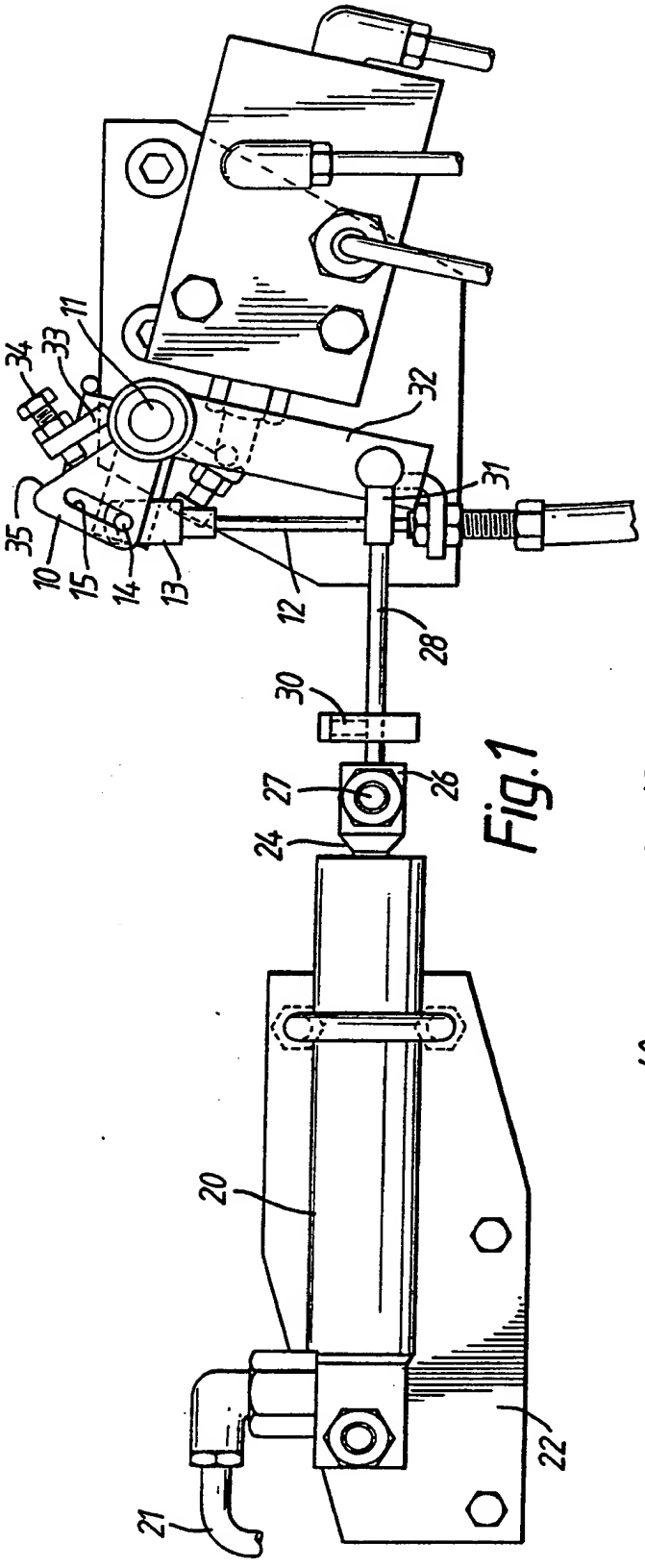
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Fig.1

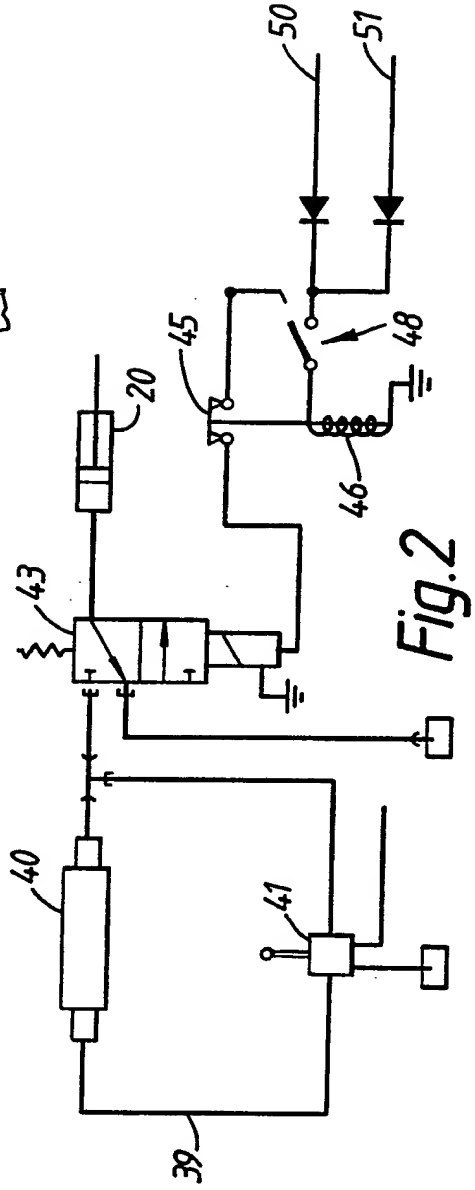
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Fig.2

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SELF-PROPELLED LIFT TRUCK

This invention relates to self-propelled lift trucks of the kind having a mast assembly, a lifting carriage moveable up and down the mast assembly, and load-engaging means (such as forks) mounted on the carriage. In such trucks, the mast assembly is frequently telescopic, having a fixed section and one or more sliding sections which can be raised and lowered by the operation of one or more hydraulic cylinders. The lifting carriage is moveably mounted on a sliding section, and is driven up and down the mast by reeving chains which pass over pullies at the top of the sliding mast section.

Such trucks are usually driven by a diesel or gas engine either directly through a conventional transmission, or via a hydraulic transmission incorporating hydraulic wheel motors, which is pressurised by a hydraulic pump driven by the engine. In either case, the engine also drives an operating pump which provides hydraulic power for the lifting cylinders and any other hydraulically-operated functions of the truck such as steering, braking, mast tilt, and carriage side-shift. The load-handling functions are controlled by a valve assembly which is operated by the driver either by conventional multiple levers acting directly on the valves, or by a "joystick" control which operates the valves through electric or hydraulic servos.

In some trucks, the circuit controlling the lifting cylinders is linked mechanically, electrically or hydraulically to the engine speed control in order automatically to increase the speed of the engine when the lift lever is operated. The object of this arrangement is to ensure that there is sufficient output from the hydraulic pump to operate the lift functions, thereby minimising the likelihood of stalling the engine if the lift lever is operated at low engine speed.

If the transmission is in the drive engaged condition when the lift lever is operated, this automatic increase in engine speed may have the additional effect of momentarily accelerating the truck, despite controls designed to prevent this. This usually presents no difficulty for a skilled driver, who is able to counteract the increased forward or reverse movement of the truck with the forward and reverse pedals or with the brakes, but it can create problems for a less skilled operator, especially if he is carefully approaching a load or stack when the lift lever is operated.

The invention provides a self-propelled lift truck in which this problem is eliminated by providing means responsive to a transmission mode of the truck for engaging or disengaging the mechanism for effecting an automatic engine speed increase.

According to the invention, there is provided a self-propelled lift truck of the kind having a mast assembly, a lifting carriage moveable up and down the mast assembly under the action of one or more hydraulic cylinders, a hydraulic control circuit for the hydraulic cylinder or cylinders, a drive motor for driving the truck through a transmission, a hydraulic pump driven by the drive motor and operable to supply hydraulic pressure to the hydraulic control circuit, hydraulic valve means under the control of the vehicle operator adapted to control fluid flow in the hydraulic control circuit, engine speed increase means operable automatically to increase the speed of the drive motor in response to operation of the valve means; and control means operable to control operation of said engine speed increase means.

The control means operates to disengage the automatic speed increase mechanism in conditions where its operation would effect the movement of the vehicle itself. With this

in mind, preferably the control means is responsive to a transmission mode of the truck, for example it may operate to disengage the mechanism so long as the transmission is in forward or reverse drive, and allow it to operate only when the transmission is in neutral, or when the hand brake is applied, or both. Manually operable switch means may be provided operable to activate and deactivate the control means. This allows the driver to select normal mode in which the engine speed increaser operates automatically whenever the lift lever is actuated, or a safety mode in which the engine speed increaser operates only when the transmission is in neutral. This position can be selected when an unskilled driver is using the truck, or when operating conditions favour use of the vehicle without this mechanism, for example when very fragile loads are being handled.

In order that the invention may be more fully understood, an embodiment in accordance therewith will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 shows part of a mechanism adapted to increase the engine speed of a lift truck in response to the operation of the lift controls; and

Fig. 2 shows a circuit for controlling the mechanism shown in Fig. 1.

Referring to the drawings, Fig. 1 shows an engine speed control mechanism for a fork lift truck comprising a throttle lever 10 connected to the fuel injection system of the engine and which is mounted for pivoting about shaft 11 under the action of throttle cable 12 connected to the accelerator or drive pedal of the vehicle. Cable 12 terminates in nipple 13 having a pin 14 which is engaged in a slot 15 formed in throttle lever 10. Lever 10 is biassed by a spring (not shown) for rotation in a clockwise direction, and pin 14 is normally held at the bottom of slot 15 by the action of this spring.

Operation of the throttle pedal 12 to increase engine revs causes a downward movement of nipple 13 in Fig. 1, entraining lever 10 via pin 14 and increasing the throttle opening, thus causing an increase in engine speed.

Interacting with this throttle control is a mechanism 16 for increasing engine speed automatically on operation of the lift controls. This mechanism comprises a hydraulic cylinder 20 connected by pipe 21 to the hydraulic servo circuit operated by the joystick control for the lift cylinders and which is mounted on plate 22 fixed to the vehicle. Cylinder 20 incorporates piston rod 24 spring-biased into the retracted position shown in Fig. 1 and which is slidably connected by collar 26 and stud 27 to actuating rod 28. Stop 30 is fixed to actuating rod 28, and extension of piston rod 24 entrains rod 28 by engagement of collar 26 with stop 30 after the small clearance shown in the drawing has been taken up. Rod 28 terminates in fitting 31 which is pivotally connected to lever arm 32, itself pivotally mounted on shaft 11. The upper end of lever arm 32 is fitted with a flange 33 carrying operating screw 34 which bears on the upper face 35 of throttle lever 10.

In the engine idle position shown in Fig. 1, pressurisation of cylinder 20 due to operation of the joystick control to call for lift causes extension of piston rod 24, entrainment of actuating rod 28 and rotation of arm 32 anticlockwise about shaft 11, operating screw 34 thereby engaging throttle lever 10 and causing an increase in engine speed. During rotation of lever 10 due to operation of cylinder 20, i.e. where no effort is being applied by the driver to the accelerator pedal, pin 14 will remain stationary in slot 15 and thus the increase in engine speed will have no effect on the position of the accelerator pedal. Equally, should the lift lever be operated during full forward drive, throttle lever 10 will already be rotated

into the position corresponding to maximum engine speed and operating screw will hav no ffect on throttle lever 10.

Fig. 2 shows a hydraulic control circuit 39 for this mechanism including the means for disabling it under appropriate conditions, for use with a truck having a hydrostatic transmission controlled by forward and reverse drive pedals.

Circuit 39 comprises a servo control circuit under the control of joystick controller 41 and intended to control operation of main lift and lower hydraulic valve 40 which in turn controls hydraulic fluid supply to the lifting cylinders. Circuit 39 incorporates a two-position electrical servo-operated hydraulic valve 43 spring-loaded into the "off" position shown in Fig. 2 but which is turned into the "on" position by completion of solenoid-operated relay 45. Relay 45 is spring-biased into the closed position shown in Fig. 2, and in this position, once the vehicle ignition is switched on, valve 43 would normally be powered into the "on" position in which hydraulic cylinder 20 is in circuit with control circuit 39 such that when joystick controller 41 is operated to actuate the lift function of the vehicle, cylinder 20 is pressurised to actuate the engine speed increase mechanism shown in Fig. 1.

Manual switch 48 is provided selectively to act on relay 45. Switch 48 is accessible to the driver and in the "on" position, this switch is open and coil 46 of relay 45 is not energised; the engine speed increase mechanism will operate whenever joystick controller 41 is operated to call for lift. When the switch is turned "off", (actually closed in Fig. 1), coil 46 can be energised to isolate the valve 43 when either of the vehicle drive pedals are depressed.

Line 50 is connected to the left-hand driv pedal and line 51 to the right-hand drive pedal. These lines are

energised by micro-switches whenever their associated pedals are depressed. When switch 48 is closed, power through line 50 or 51 will energise coil 46 to operate relay 45 and allow valve 43 to pass under its spring bias into the "off" position in which the engine speed increase mechanism is inoperative. Selecting neutral (or applying the handbrake) de-energises lines 50, 51 and relay 46, re-establishes connection via relay 45 and moves hydraulic valve 43 into the "on" position. The two-position switch 48 thus gives the driver the choice of selecting normal mode in which the engine speed increaser is operative regardless of the transmission position, or a safety mode in which the engine speed increaser is operable only in the safe, transmission disengaged, condition.

CLAIMS

1. A self-propelled lift truck comprising a mast assembly, a lifting carriage moveable up and down the mast assembly under the action of one or more hydraulic cylinders, a hydraulic control circuit for the hydraulic cylinder or cylinders, a drive motor for driving the truck through a transmission, a hydraulic pump driven by the drive motor and operable to supply hydraulic pressure to said hydraulic control circuit, hydraulic valve means under the control of the vehicle operator adapted to control fluid flow in said hydraulic control circuit; engine speed increase automatically to increase the speed of the drive motor in response to operation of said valve means; and control means operable to control operation of said engine speed increase means.

2. A self-propelled lift truck as claimed in Claim 1, wherein said control means is responsive to a transmission mode of the truck.

3. A self-propelled lift truck as claimed in Claim 2, wherein said control means is operable to disable said engine speed increase means when the transmission is in a drive engaged condition.

4. A self-propelled lift truck as claimed in Claim 2 or Claim 3, wherein said control means is operable to disable said engine speed increase means when the brakes of the vehicle are applied.

5. A self-propelled lift truck as claimed in any of claims 1 to 4, wherein manually operable switch means are provided selectively to activate and deactivate said control means.

6. A self-propelled lift truck, substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) -9-	Application number GB 9319316.7
Relevant Technical Fields (i) UK Cl (Ed.L) B7H (HDC,HXG,HXJ) (ii) Int Cl (Ed.) B60K 28/00, 28/10; B66F 9/075, 9/22; F02D 29/02; 35/00	Search Examiner J L TWIN Date of completion of Search 10 NOVEMBER 1993
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASE: WPI	Documents considered relevant following a search in respect of Claims :- 1-6

Categories of documents

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P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 1308568	(HUDSWELL BADGER)	1
A	US 4124095	(NISSAN)	1

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